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Enhanced photonic-plasmonic laser emission from Zinc-doped GaAs nanowires FATEMESADAT MOHAMMADI, Department of Physics, Univ of Cincinnati, MYKHAYLO LYSEVYCH, HOE TAN, CHENNUPATI JAGADISH, Research school of Physics and Engineering, The Australian University, MARTIN FRAENZL, Department of Physics, University of Leipzig, HANS PETER WAGNER, Department of Physics, Univ of Cincinnati — Excitation power and temperature dependent lasing from Zinc-doped GaAs nanowires on glass and on metal films was investigated. NWs with an average diameter of 250 nm and 8 nm Al_2O_3 as top coating, were laid on glass, showed photonic lasing of the TE10 mode when the excited pulsed laser intensity exceeded 53 μJ/cm^2. Similar NWs on a metal film showed enhanced lasing and reduced excitation threshold that is attributed to the contribution hybrid photonic/plasmonic lasing modes. We suggest that the stronger light field confinement in the vicinity of the metal as well as the energy transfer from the NW emission to surface plasmons in the metal film leads to enhanced gain and reduced laser threshold. Observed blue shift of the NW lasing emission as a function of excitation intensity up to 200 μJ/cm^2 is attributed to band filling. The subsequent red-shift at higher intensities is caused by band-gap renormalization. At higher temperature, we observe both a red-shift and weakening of the emission that is attributed to band gap shrinkage and increasing non-radiative losses. While NWs on metal show lasing up to room temperature NWs on glass stop emitting at ˜200 K. The enhanced robustness of lasing from NWs on metal is again attributed to light confinement and coupling with metal plasmons.

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